The Journal of HEREDITY

A DEFECT IN THE PUPILS OF IDENTICAL TWINS

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Parent of the California Alligator Pear Industry

The Inheritance of Social Competence

Split-hand—A Recurring Hereditary Defect

Color Inheritance in Shorthorn Cattle

Production of Chicken × Turkey Hybrids

VOLUME 28 MAY, 1937 NUMBER 5

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The

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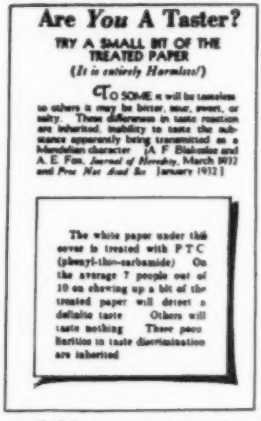
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Last year the "Taster test" served as an introduction to human genetic differences in many classrooms. The test is so easily made with the treated paper, and arouses such great interest that it appears to have a definite place in group demonstrations of such differences. These leaflets, size 3⅜" by 5½", are available in quantities for those who wish to use them for classroom or lecture purposes. On the back is printed an outline 4-generation pedigree chart. Sample on request. Prices: 10 for 25c; 50 for $1.00.

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CLIMBING THE LADDER OF SOCIAL MATURITY

Frontispiece

From new born babe to the leader who "advances general welfare" each human being reaches a certain stage of social integration which largely determines how he will function in the social organization of mankind. There is a tremendous variation in the extent to which different individuals attain to social maturity. This picture mosaic attempts to suggest a few of the 117 graded steps which are comprised in the Vineland Social Maturity Scale (See Figure 1). Reading from upper left to lower right the steps shown are: "Crows, laughs" (Item 1); "Balances head" (Item 2); "Grasps with thumb and finger" (Item 13); "Pulls self upright" (9); "Plays with other children" (27); "Initiates own play activities" (36); "Plays difficult games" (85); "Contributes to social welfare" as a teacher (104); "Has a job or continues schooling" (98); "advances general welfare" through public service, research (117).

THE INHERITANCE OF SOCIAL COMPETENCE*

EDGAR A. DOLL
The Training School at Vineland, N. J.

EUGENICS aims to improve society through selective mating. This purpose requires an understanding of the mode of hereditary transmission of human ability before sound administrative programs for race betterment can be advocated. The thesis of this paper is that quantitative measurement must replace qualitative estimation in family history studies before the inheritance of human aptitudes can be clearly understood.

Our notions of social competence have been closely identified with concepts of general intelligence, as reflected in genius or mental deficiency. We need direct measures of social ability as a practical expression of intelligence, and we need these for the whole distribution of ability as well as for the extremes of superiority and inferiority. Without such measurement methods, field work in family history studies is likely to be wishful or prejudiced, and the definite influence of such variables as age, sex, environment, and the like cannot be allowed for. To infer a mode of transmission without adequate measurement may lead to loose definition and encourage confusion of cause and effect.

If we could employ an instrument approximating laboratory accuracy for measuring social competence at successive age levels, for both sexes and in varied environments, which would provide quantitative data of known reliability and validity, we could make definite advances in standardizing field work and in obtaining a clearer understanding of the laws of hereditary transmission of social competence. If by means of such a device we could examine an individual either in person or *in absentia* by a simple standardized schedule, we might expect to extend the scope of family history studies to persons who are inaccessible by reason of death or geographical isolation. And if we could verify our measurements by re-examination of the same person by the same schedule from different approaches, we could greatly increase the reliability of the evidence on which eugenical programs must be based.

These considerations induce us to call the attention of this Association to the Vineland Social Maturity Scale, a recently standardized device for the measurement of general social competence from birth to maturity as a developmental or maturation process. This scale was originally devised to measure the social abilities of persons suspected of mental deficiency, in order to satisfy the first criterion of mental deficiency, social incompetence. The basic method is the same as that employed by Binet and Simon in their measuring scale of general intelligence. Just as Binet's concept of general intelligence was based upon a hierarchy of developmental performances each of which reflected a general factor of intelligence, so our scale is based on a progression of behavioral performances each of which reflects personal independence and social responsibility. (See Figure 1.)

This scale assumes that individual growth and development are accompanied by a maturation of behavior which is socially significant and which represents the practical expression of increase in related abilities. The in-

*Presented at the twenty-fourth annual meeting of The (American) Eugenics Research Association, New York, June 6, 1936. The author is indebted to Katherine Preston Bradway for the collection of data herewith, and for helpful suggestions in treatment.

THE VINELAND SOCIAL MATURITY SCALE

The revised scale is printed herewith. Each item of the Scale has been given a categorical designation which is indicated by the following letters:

S H G—self-help general	O—occupation
S H E—self-help eating	C—communication
S H D—self-help dressing	L—locomotion
S D—self-direction	S—socialization

Categories	Items	
		0 - I
C	1.	"Crows"; laughs
S H G	2.	Balances head
S H G	3.	Grasps objects within reach
S	4.	Reaches for familiar persons
S H G	5.	Rolls over
S H G	6.	Reaches for nearby objects
O	7.	Occupies self unattended
S H G	8.	Sits unsupported
S H G	9.	Pulls self upright
C	10.	"Talks"; imitates sounds
S H E	11.	Drinks from cup or glass assisted
L	12.	Moves about on floor
S H G	13.	Grasps with thumb and finger
S	14.	Demands personal attention
S H G	15.	Stands alone
S H E	16.	Does not drool
C	17.	Follows simple instructions
		I - II
L	18.	Walks about room unattended
O	19.	Marks with pencil or crayon
S H E	20.	Masticates food
S H D	21.	Pulls off socks
O	22.	Transfers objects
S H G	23.	Overcomes simple obstacles
O	24.	Fetches or carries familiar objects
S H E	25.	Drinks from cup or glass unassisted
S H G	26.	Gives up baby carriage
S	27.	Plays with other children
S H E	28.	Eats with spoon
L	29.	Goes about house or yard
S H E	30.	Discriminates edible substances
C	31.	Uses names of familiar objects
L	32.	Walks upstairs unassisted
S H E	33.	Unwraps candy
C	34.	Talks in short sentences
		II - III
S H G	35.	Asks to go to toilet
O	36.	Initiates own play activities
S H D	37.	Removes coat or dress
S H E	38.	Eats with fork
S H E	39.	Gets drink unassisted
S H D	40.	Dries own hands
S H G	41.	Avoids simple hazards
S H D	42.	Puts on coat or dress unassisted
O	43.	Cuts with scissors
C	44.	Relates experiences
		III - IV
L	45.	Walks downstairs one step per tread
S	46.	Plays cooperatively at kindergarten level
S H D	47.	Buttons coat or dress
O	48.	Helps at little household tasks
S	49.	"Performs" for others
S H D	50.	Washes hands unaided
		IV - V
S H G	51.	Cares for self at toilet
S H D	52.	Washes face unassisted
L	53.	Goes about neighborhood unattended
S H D	54.	Dresses self except tying
O	55.	Uses pencil or crayon for drawing
S	56.	Plays competitive exercise games
		V - VI
O	57.	Uses skates, sled, wagon
C	58.	Prints simple words
S	59.	Plays simple table games
S D	60.	Is trusted with money
L	61.	Goes to school unattended
		VI - VII
S H E	62.	Uses table knife for spreading
C	63.	Uses pencil for writing
S H D	64.	Bathes self assisted
S H D	65.	Goes to bed unassisted
		VII - VIII
S H G	66.	Tells time to quarter hour
S H E	67.	Uses table knife for cutting
S	68.	Disavows literal Santa Claus
S	69.	Participates in pre-adolescent play
S H D	70.	Combs or brushes hair
		VIII - IX
O	71.	Uses tools or utensils
O	72.	Does routine household tasks
C	73.	Reads on own initiative
S H D	74.	Bathes self unaided
		IX - X
S H E	75.	Cares for self at table
S D	76.	Makes minor purchases
L	77.	Goes about home town freely
		X - XI
C	78.	Writes occasional short letters
C	79.	Makes telephone calls
O	80.	Does small remunerative work
C	81.	Answers ads; purchases by mail
		XI - XII
O	82.	Does simple creative work
S D	83.	Is left to care for self or others
C	84.	Enjoys books, newspapers, magazines
		XII - XV
S	85.	Plays difficult games
S H D	86.	Exercises complete care of dress
S D	87.	Buys own clothing accessories
S	88.	Engages in adolescent group activities
O	89.	Performs responsible routine chores
		XV - XVIII
C	90.	Communicates by letter
C	91.	Follows current events
L	92.	Goes to nearby places alone
S D	93.	Goes out unsupervised daytime
S D	94.	Has own spending money
S D	95.	Buys all own clothing
		XVIII - XX
L	96.	Goes to distant points alone
S D	97.	Looks after own health
O	98.	Has a job or continues schooling
S D	99.	Goes out nights unrestricted
S D	100.	Controls own major expenditures
S D	101.	Assumes personal responsibility
		XX - XXV
S D	102.	Uses money providently
S	103.	Assumes responsibilities beyond own needs
S	104.	Contributes to social welfare
S D	105.	Provides for future
		XXV+
O	106.	Performs skilled work
O	107.	Engages in beneficial recreation
O	108.	Systematizes own work
S	109.	Inspires confidence
S	110.	Promotes civic progress
O	111.	Supervises occupational pursuits
S D	112.	Purchases for others
O	113.	Directs or manages affairs of others
O	114.	Performs expert or professional work
S	115.	Shares community responsibility
O	116.	Creates own opportunities
S	117.	Advances general welfare

BASIS OF THE SQ

Figure 1

The Vineland scale is accompanied by detailed instructions[4] which experience has shown make possible an objective evaluation of the extent to which an individual has attained social maturity. The Roman numerals divide the scale into chronological ages for which the various "steps" are normal. Copyright by Dr. E. A. Doll.

fant at birth is helpless and dependent. As he grows up, he "takes over" more and more responsibility for his own care, gradually extends the scope of his personal responsibility to the management of his own affairs, and ultimately dominates the affairs of others. In infancy this increasing social competence is expressed principally as self-help, in adolescence as self-direction, and at maturity as an assumption of responsibility for the needs of others. In senescence the individual may again become dependent in the completion of the life cycle.

In formulating the *modus operandi* of social competence thus conceived, we have employed six major expressions of social independence and responsibility, namely: self-help, locomotion, communication, occupation, self-direction, and socialization. Each of these major categories of social behavior has for our purposes been reduced to a succession of specific performances of increasing complexity with advance in age. Each detailed performance has its own maturation period, or growth curve, which reflects individual differences in rate of development. The central tendency of each growth curve can be calculated and its dispersion determined in statistical terms. The sum of the item performances can be expressed as a total score which reflects the degrees of maturation in social competence. The scores can be expressed as central tendencies for successive life-age groups and thereby expressed as "social ages." These are methodologically and statistically comparable to Binet mental ages. These social ages (SA's) may be expressed as social quotients (SQ's) analogous to intelligence quotients. Individual variation from these central tendency age scores can be calculated, and the influence of such variables as sex, race, and cultural level can be investigated. The items of the scale avoid the measurement of intelligence, personality, habit, skill, and the like, as such, focusing instead on the composite capitalization of such abilities for socially significant behavior.

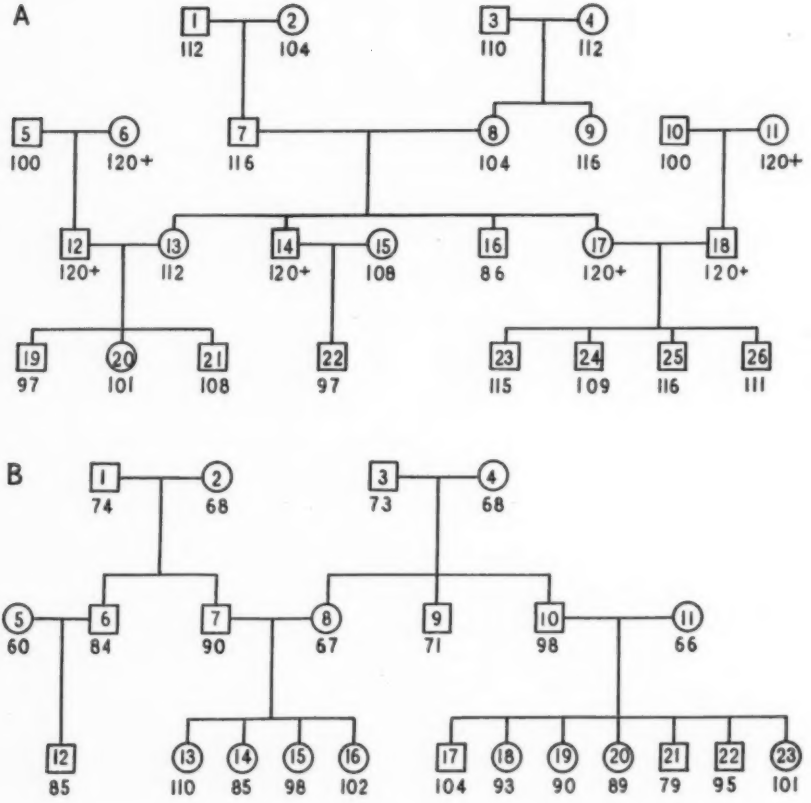
The method is not a rating scale, but a measurement device. It does not require the direct examination of the person concerned. On the contrary, information regarding the person examined is obtained through an informant who is intimately acquainted with the habitual social behavior of the person examined. This aspect of the scale is a decided advantage, since it provides measurement of a subject without requiring his presence. However, a person may be examined directly by acting as his own informant.

It is neither practicable nor necessary to present here the details of this method, the experimental background of its standardization, nor the study of related variables. The bibliography will suffice for this purpose. A more complete report on the method and some of these ramifications is now being prepared in book form. Some comment, however, is necessary with respect to certain details that are critical when the method is employed in family history studies.

The reliability coefficient for repeated examinations employing different examiners and different informants is $r = .94$. The median difference between comparative examinations is .5 years. The extreme range of deviations rarely exceeds ± 15 points SQ. Some data on the effect of re-examinations in family history studies are presented below.

The validity of the method is indicated by correlations between obtained social ages and estimated social ages which center around $R = .85$ for a number of institutional cottage groups comprising 250 feeble-minded subjects. The difference between the means of these arrays is .2 years.

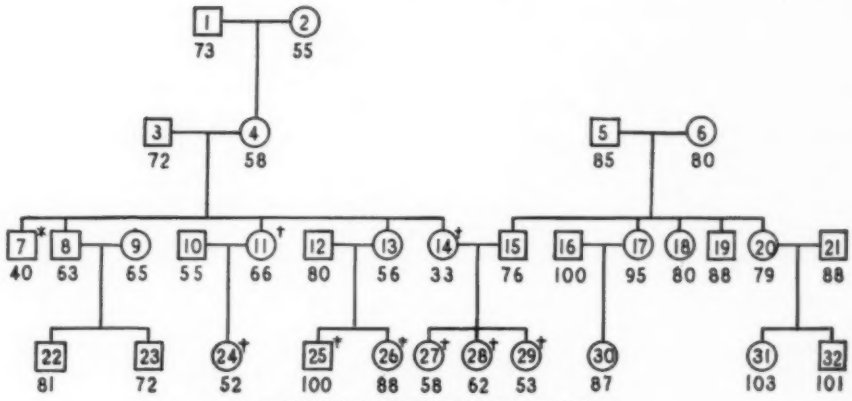
Experimental validation with about 350 institutionalized feeble-minded subjects suggests that SA 18 years marks the upper limit of adult mental deficiency and the lower limit of adult normality without overlapping, except where special disabilities require special interpretation of scores. The same material shows that SQ's above 80 are



FAMILY SIMILARITIES IN SOCIAL MATURITY QUOTIENTS

Figure 2

A shows the social quotients (SQ) of the E-C-A-B family. All of the SQ's are within the normal range or slightly above it, showing a general superiority in social competence. The numbers within the symbols in this and the succeeding charts are the same as the subject numbers in Table I. Numbers below the symbols are the Social Quotients (SQ's) of the various individuals. It is possible by careful application of the Vineland Social Maturity Scale to arrive at a numerical statement of the individual's social maturity that is quite comparable to the Stanford Binet evaluation of an individual's intellectual development. *B* shows the "SQ pedigree" of the G-T family in which SQ's range from subnormal to average normal with none significantly above the average. What elements in these marked family resemblances in SQ are due to heredity and what to environment has not been definitely proven, but the impression gained by those who have applied the method is that heredity plays a very important part in the determination of the social maturity which an individual is likely to attain.



A SOCIALLY SUBNORMAL FAMILY

Figure 3

This chart shows four generations in the *L-A* family in which general social inferiority (with institutionalized mental deficiency and intermarriage between subcultural and borderline stock) has taken place. * = Epileptic; † = Institutionalized as mentally deficient; ‡ = Paternity doubtful but apparently of indicated father.

infrequent among feeble-minded subjects and that SQ's below 70 indicate marked suspicion of deficiency. The SQ range between 70 and 80 is a borderline range according to the present data. Of course, mental deficiency is not to be inferred from social ages or social quotients alone, but should be interpreted in the light of other data, especially developmental history, mental level, and special disabilities. Scores which are influenced by such handicaps as blindness, deafness, crippling, and the like, must be interpreted in relation to these handicaps.

Relation of IQ's and SQ's

Methodologically, SA's and SQ's are fairly comparable with Binet MA's and Binet IQ's. However, it is to be noted that Binet MA scores appear to reach the adult average level at about 14 years, whereas SA scores reach their adult average level at 25 years, and these ages respectively are taken as constant divisors for calculating quotient scores beyond these life ages for the respective scales. Special care must therefore be taken in comparing SQ's with Binet IQ's to remember that the corresponding SA's and MA's are not the same after LA 14 years. Thus, an adult SQ of 50 corresponds to an adult SA of 12.5 while an adult IQ of 50 corresponds to an adult MA of 7. This caution is specially important in reading family history charts. Only the quotients are given on our charts; the SA's are given in Table I. Adult SA's are reduced to SQ's by multiplying the SA by the constant, 4, (100 × the reciprocal of 25). Consequently, adult SQ's may be converted back to SA's by dividing by the constant, 4.

SA scores among feeble-minded subjects are approximately equal to MA scores up to about LA 15 years; thereafter they average about one year higher than MA scores. SA's among feeble-minded subjects are only slightly affected by life age or by length of institutional residence, as expressions of experience and environmental influence. SQ's tend to equal IQ's for institutional feeble-minded subjects up to LA 15; thereafter the average difference is approximately 15-20 points in favor of IQ. This is due to the higher life-age limits used in computing adult SQ's (14 years for IQ, and 25 years for SQ, as noted above) and the tendency of the final SA

to be reached by feeble-minded subjects before 20 years of age rather than after. Among dull-normal subjects, SQ's tend to exceed IQ's.

The correlation between SA scores and Binet MA scores is $r = .85$ for about four hundred institutional feeble-minded subjects. As noted, the SA's are approximately one year higher than the MA's after LA 15 years. Of course, this high correlation does not mean identity, but only mutual dependence on related factors.

In order to demonstrate the practicability of the method in eugenic research we offer some data for three family histories. One of these is a normal strain with superior social-economic status, education, and professional attainment. The second strain is derived from the study of a special class child in the public schools and shows a borderline or subcultural family group. The third strain is derived from a feeble-minded family with ramifications in subcultural stock.

These family strains are presented by family history charts shown in Figures 2 and 3. The propositi in each chart are numbered consecutively from left to right beginning with the farthest removed generation. Below each symbol is the SQ for the person represented. Additional data showing LA, SA, SQ, and "corrected SQ" are presented in Table I. Mid-parent and child relationships are plotted in Table II.

In applying the scale to these three family groups, our purpose is only to illustrate the use of this method in family history studies. But with these charts before us, we are immediately confronted with a challenge to interpret them, although of course such interpretations can have only suggestive value with such limited data. Even casual study of these charts at once raises a number of questions and suggests hypotheses which have not previously been emphasized in the absence of such data.

The first step in such interpretation is to question the data themselves, since measurements always invite more precise evaluation than do qualitative estimates. The following discussion is therefore offered to establish confidence in the data.

1. To what extent do these social-age scores reflect environmental influence? Are the scores reliable measures of hereditary potential, or do these scores reflect environmental suppression or facilitation of these potentials? These questions are pertinent although they seldom have been raised in family history studies where the accomplishments of the persons concerned are based on descriptive estimates rather than numerical measurements.

We have already established sufficient experimental evidence to indicate that these social-age scores reflect maturation of native potential with only minor modification due to environmental influence. Each item of the scale is, of course, influenced to some degree by environmental opportunity and training, whether positive or negative, but the amount of this influence is seldom greater than the standard deviation of the ages for which the items are normative. Similarly the influence of environment does not modify the total scores by appreciably larger amounts than is represented by the standard deviation of these scores.

We have studied the effect of social status on these scores, and the influence is not serious except for the *selective* influences involved in occupational status. It must be recalled that this scale attempts to measure the composite capitalization of all individual abilities as reflected in the functional social end-results of these abilities. Insofar as environment influences the scores of other than particular items, sometimes positively and sometimes negatively, the environment must be considered as influencing all aspects of individual maturation. These underlying abilities, of which intelligence itself is the most potent, are themselves generally understood to be relatively little subject to environmental modification. Nevertheless, we are not justified in asserting

that these scores are unalloyed measures of hereditary potential. We are, however, justified for the present in assuming that these scores afford fairly dependable measures of those potentials.

2. To what extent are these scores comparable from generation to generation in the light of social evolution? Certainly the social environment of today is different from that of one hundred years ago. Does this scale afford a fairly universal measure of social maturation without reference to the social conventions and opportunities which change with time, place, and circumstance? There are good reasons, both logical and experimental, to indicate that the scale does measure the more or less universal aspects of social maturation without seriously disturbing effects of time, place, and circumstance. This assumption is fairly evident from a consideration of the items themselves which have been formulated in such a way as to be relatively independent of these variables. This assumption cannot be upheld for all items of the scale, but only for the majority of them. For example, certain of the communication items which involve literacy are obviously subject to environmental influence, but the number of these is not large, and their effect would not be seriously felt because of their dispersion throughout the whole scale. Certain other items of the scale might require re-definition or modified interpretation in particular environments, but this is permissible within the method which enables the skilled examiner to make due allowances for exceptional circumstances. In fact, when the environment offers no opportunity for the expression of a given performance, the method provides for this contingency. These "no opportunity" scores would rarely be concentrated in a particular area of the scale, thereby affecting a particular subject unduly. Further support is found in the results of applying the scale to deaf, blind, and crippled subjects, but the argument need not be presented here.

3. How reliable are the scores obtained on the more remote ancestors? The method provides for the examination of any person regarding whom reliable information can be obtained. Moreover, the method also provides internal checks on the accuracy of the information. If the informant is not adequately informed, this will be evident to competent examination and the obtained score will be indicated as unreliable, or as reliable within a certain margin of error. Since the method, if adequately applied, provides for a thorough evaluation of each item in terms of factual evidence, adequate scores cannot be established if adequate evidence is not available. However, in family history studies covering four generations, or even five, there is usually little difficulty in obtaining informants who are sufficiently contemporary with the propositi to obtain reliable

TABLE I. Data for Members of Three Family Groups

Superior Family (Chart I)					Subcultural Family (Chart II)				Feeble-Minded Family (Chart III)			
Re-ex Chart	LA	SA	SQ	Corr. SQ	LA	SA	SQ	Corr. SQ	LA	SA	SQ	Corr. SQ
1	71.5	88.0	112		Adult	18.5	74		Adult	18.3	73	
2	68.5	88.0	124		Adult	17.0	68		Adult	19.9	82	
3	57.5	87.0	150		72.5	18.5	70		Adult	18.0	78	
4	49.5	88.0	152		Adult	17.0	68		Adult	14.4	58	
5	67.5	88.0	120		56.5	15.0	60		Adult	21.5	85	
6	31.5	80 +	180		Adult	21.0	84		Adult	20.0	80	
7	68.5	89.0	114		80.5	22.5	90		27.3	10.0	40**	
8	80.5	89.0	106		48.5	16.5	67		Adult	19.5	63	
9	80.5	89.0	116		49.5	17.6	71		80.5	14.6	65	
10	80.5	89.0	100		47.5	24.4	98		80.1	13.5	55	
11	80.5	80 +	120		47.5	10.5	44		Adult	14.5	60?	
12	44.5	80 +	180		16.5	14.0	85		28.5	20.0	80	
13	44.5	88.0	112		8.7	2.8	119	110	Adult	14.1	56	
14	47.5	80 +	180		9.0	7.1	79	88	29.2	8.3	330	
15	48.5	87.0	158		10.4	10.5	98	98	48.5	18.9	78	
16	72.0	89.0	888		19.5	19.8	102		28.5	25.0	100	
17	44.5	80 +	180		8.0	8.4	105	104	Adult	20.5	95	
18	44.5	80 +	180		9.5	8.4	91	93	25.5	19.9	80	
19	7.5	7.5	96	97	11.5	9.7	87	90	29.5	21.9	82	
20	18.5	18.5	101		12.5	10.5	89		22.5	19.7	79	
21	14.5	14.0	108		13.7	10.8	79		24.5	21.0	88	
22	17.0	17.5	97		16.5	15.5	93		3.0	2.5	64	61
23	6.4	7.7	120	115	19.0	19.9	105		6.4	5.2	69	72
24	9.5	10.4	112	109					13.5	7.0	52?	
25	14.1	18.5	116						1.7	1.7	100	100?
26	18.0	20.0	111						5.5	6.9	84	88?
27									15.9	8.1	52?	
28									10.1	9.5	49?	
29									20.4	10.9	53?	
30									16.8	14.4	87	
31									0.2	0.2	104	108
32									14.6	14.7	101	

* No special disabilities present
** Epilepsy present
? Institutionalized as mentally deficient
§ Paternity doubtful but apparently in line

TABLE II. Mid-Parent and Child Relationship

Child SQ	Mid-Parent SQ 50	60	70	80	90	100	110	120	N
30		1							1
40		1							1
50	2	3							5
60	1	2	1	1					5
70		1	1	2					4
80		2	3	3	1		1		10
90			3	4			2		9
100		1	1	4			3	1	10
110				1		1	2	3	7
120							4		4
N	3	11	10	16	1	1	12	4	56

Mid-Parent med. = 81.5; Child med. = 79.5; $\frac{\sigma}{\sqrt{N}}$ = .75, PE .06

scores. The reliability of scores as obtained from different informants, even in remote generations, is reflected in certain sample cases contained in the data herewith. It is to be noted that scores on these remote generations were obtained from informants who were contemporary with the person scored.

4. To what extent does literacy affect the scores? This is a specific case of environmental influence. Eight items of the scale directly involve literacy, that is, reading or writing or both. Literacy is also a contributing factor in other items, but not sufficiently so as to affect seriously the scale as a whole. If illiteracy is present due to lack of native ability rather than to lack of environmental opportunity, this disability will be reflected in the items concerned. Items which reveal environmental lack rather than innate disability can be scored "plus no opportunity," and these scores have the effect of full pluses within the otherwise plus range of the examination (see manual). Nevertheless, insofar as illiteracy does constitute a generalized deficiency it may color the examination as a whole for particular subjects. In such cases the examination is so indicated within the method, and allowance must be made as for other special handicaps.

5. What is the effect of such special handicaps as blindness, deafness, crippling, the consequences of specific diseases, and even of mental deterioration? In such cases the handicap may interfere with the fruition of hereditary potential for social competence. One study, for example, shows that the mean SQ for deaf subjects is 80 ± 10 at each life age from 6 to 19 years, as compared with SQ 100 which is normative for hearing subjects. In cases of special handicap, therefore, the obtained score must be discounted, corrected, or otherwise interpreted in the light of the handicap. Such scores must therefore be considered as reflecting a certain degree of blight from the point of view of the realization of the hereditary potential. When adequate data are obtained it will be possible to employ standard corrections for such handicaps.

6. What is the effect of senility or of deterioration from any cause? In the case of adults, the method provides for obtaining a social-age score at the time of the subject's prime. If, therefore, a person is examined who is beyond his prime, and whose examination shows the effect of senility or deterioration from any cause, this fact is noted by the examiner and the examination produces two scores, namely, the social competence of the individual at the time of the examination, and also at his prime. For family history purposes these prime scores must be used, since they reflect the hereditary potential. However, the tendency toward deterioration may itself be a family history trait, and could therefore itself be studied by this method. It is quite conceivable that mental longevity might be a family trait, as vital longevity appears to be, senility appearing as a trait in some families and not in others, or at different age periods in different families.

The possibility of examining subjects at their prime is one of the particular advantages of the scale. Assuming an adequate informant, it is possible to obtain a subject's score at any life age for which information is adequate. Indeed, the adequacy of this information can itself be determined by the method. The method therefore not only enables one to obtain scores on persons who are inaccessible to direct examination, but also to obtain scores at different periods in the subject's life. It is therefore possible to plot what may be called a retrogressive growth curve of the individual's development. Assuming adequate data, it would therefore be possible to plot family history tendencies not only as to familial rates of development, but also as to ultimate levels of development and the tendency toward, or absence of, familial deterioration.

7. If the family history includes persons below adult years, can the

scores for these juveniles be included as part of the family history study? In studying the hereditary transmission of abilities it is necessary that the abilities be studied at their maturation optimum, as well as with reference to the environmental facilitation or restriction of their expression. We have already noted that adult scores should be taken at their prime. It is obvious that the scores of juveniles cannot be considered as prime scores. Juvenile scores must therefore be projected to their adult equivalence on some assumption as to what these scores might be (by prediction) when these juveniles become adults. This is a question which has seldom been raised in family history investigations which tacitly imply that the present status of juveniles may be taken as indicative of their adult status (on the implicit assumption that individual development proceeds at a constant rate, namely, that the superior child will be a superior adult, that the inferior child will be an inferior adult, and similarly for other degrees of ability). For average-normal groups, this assumption is probably sound, but there is much reason to believe that both genius and deficiency become aggravated with age.

In the case of this scale, we have tentatively established that twenty-five years is the average adult life-age limit of social maturation. Social quotients for subjects above twenty-five years are therefore calculated at this limit. These social quotients may be employed as measures of relative development as is done with intelligence quotients (which, however, are computed for adults at their corresponding developmental mean adult limits). In the case of persons under twenty-five years of age, the social quotient is obtained by dividing the social age by the actual life age, and these quotients are assumed to be comparable as relative measures. However, these social quotients are not statistically comparable under twenty-five years of age unless corrected for the tendency of their average deviatiton (AD) to decrease as life age increases. Such corrections can be made as indicated below and have been made for our data in those few instances where the correction applies.* However, there is some unknown error in predicting the adult social quotients of *individual* juveniles, since the average constancy of the social quotient cannot be applied to particular cases. It may be assumed from methodological considerations that these social quotients are fairly comparable to Stanford-Binet intelligence quotients, and that superior quotients may tend to increase, while inferior quotients may tend to decrease, this in spite of the general tendency for the average deviation of these quotients to decrease for the distribution as a whole.

This discussion indicates the type of critical evaluation of data that may be indulged in before proceeding to eugenical or biological consideration of these family history charts. Obviously, such

*In our standardization sample (twenty subjects of each age from birth to thirty years) the average deviation of SQ throughout the developmental period shows three major phases. According to these rather limited data, the AD of SQ is approximately 13.5 points from birth to five years, approximately 9.5 points from five to twelve years, and approximately 7 points for life ages after twelve. There is some fluctuation in AD for the specific ages within these periods, but the trend shows these three major variations. In order to reduce SQ's at all ages to a comparable basis, it is practicable to convert them to the adult average variability by the formula

$$SQ_A = 100 + 7\left\{\frac{SQ-100}{AD_X}\right\}$$

where SQ_A is the obtained SQ converted to standard adult variability, 100 is the average SQ at all ages, 7 is the adult AD of SQ, and AD_X is the AD of SQ corresponding to the age of the person examined. Correction for SQ's as given in Table 1 have been made in this way and so used for purposes of adult comparison on the charts.

interpretations should not be attempted until confidence in the data has been established. The discussion has been offered to discourage offhand discounting of the data, and the consequent explaining away of the biological interpretations which must be dealt with if the data can be accepted at face value. These difficulties are inherent in *any* method of family history study. One merit of the present method is that it draws attention to basic considerations that have heretofore been unquestioned.

For at least illustrative purposes, let us then accept the data at face value and proceed to some consideration of the implications for eugenics. Here the writer is inclined to shift the responsibility to more competent shoulders. However, some problems are immediately obvious. In the family of superior status, Figure 2*A*, the general level of superiority is maintained through four generations, and the matings in the main are within average or superior limits. Nevertheless, there is observable a slight regression toward the average normal in the succeeding generations. Thus, if we take social quotients of 110 and above, we find these present in three-fourths of the first generation (the most remote ancestors), in four-sevenths of the second generation, in five-sevenths of the third generation, and in three-eighths of the fourth generation. Or if we consider quotients below 100, we find these in none of the first generation, in none of the second, in one-seventh of the third, and in two-eighths of the fourth. Or if we consider the mean quotients, these are 109 in the first generation, 111 in the second generation, 112 in the third generation, and 107 in the fourth generation. Therefore, although the central tendency of social quotients is maintained within narrow limits from one generation to another, we note some tendency for the proportion of superior quotients to decrease and of inferior quotients to increase.

Proceeding to Figure 2*B*, which is a borderline or subcultural family with one child in a special class, we note a somewhat different situation. Here the propositi in the first generation are at the borderline of mental deficiency. These scores, however, are influenced in some degree by illiteracy in this generation, even though this generation is not so remote nor so environmentally impoverished that literacy might not be properly expected under the environmental circumstances. In the second generation, four out of seven propositi are at the borderline of mental deficiency, two are at the dull-normal range, and one is at the average-normal standard. It is of some interest that the three subjects whose quotient scores are within normal limits are all males and their marriages are with women whose quotient scores are at the mental deficiency level. However, the children of these three marriages are without exception within normal or borderline-normal limits, the lowest quotient being 79, and the highest 110. In this family, therefore, we observe a definite tendency for the social quotients to proceed from feeble-minded limits to average-normal limits, even though the matings include mothers who are themselves within feeble-minded limits, and fathers who tend toward normal or dull-normal limits. This chart is therefore specially significant as indicating normality arising within stock that borders on mental deficiency, even though the matings are with other mentally deficients. This chart can hardly be considered as confirming the principle of Mendelian inheritance of mental deficiency. The extent to which the quotient scores of these juveniles might be considered as possibly indicative of ultimate deficiency may be conjectured from examination of the data in the tables. It is possible that these quotients may decrease with advancing age, but probably not so much as to reach the deficiency level.

Figure 3 portrays a mentally deficient stock, many of whose female members have been committed to an institution for the feeble-minded. With-

in this mentally deficient stock, as represented on the left hand side of the chart, the mental deficiency is seen to be transmitted for the most part in kind, but in varying degrees, although three descendants in this stock and three matings show a tendency toward the normal. This stock is seen as mating with a subcultural family not amounting to deficiency, as seen on the right hand side of the chart, and in this branch there is a definite tendency toward improvement in social quotients in the youngest generation, proceeding from borderline normality to average-normal standards. While this chart tends to confirm the Mendelian type of inheritance, there are numerous individual exceptions and the chart is not easily interpreted in the light of Mendelian theory.

In making these comments, we are inclined to accept the data at face value. Limited though these data may be, they suggest the importance of approaching the problem of the inheritance of human abilities as reflected in social competence with fresh consideration of the modes of inheritance. The biological aspects of the problem are not within the province of the present paper, which aims only to propose a method by means of which these problems may be considered more effectively in the future than they have been in the past. While the writer is disinclined to discuss this problem with reference to previous contributions in the fields of biology and eugenics, special reference may be made to the recent paper by Frederick Grundy[9] which is specially relevant to many of the issues raised in the present paper.

The reliability of the method from the point of view of the stability of obtained scores has been sampled for family history purposes by repeating certain examinations. For this purpose seven persons in the superior family, Figure *2A*, were re-examined by the same examiner using different informants. These results are as follows: two examinations of Subject 6 gave SQ's 112 and 120+; four examinations of Subject 8 gave SQ's 102, 102, 104, and 106 (one SQ of 102 was a self-informing examination); three examinations of Subject 12 gave SQ's 112, 114, and 120+; six examinations of Subject 13 gave SQ's 108, 114, and 112 four times (the SQ of 114 in this case was a self-informing examination); two examinations of Subject 14 gave SQ 120+ in both instances; two examinations of Subject 16 gave SQ 86 both times; four examinations of Subject 17 gave SQ's 110 and 120+ three times; two examinations of Subject 21 gave SQ 108 both times (one SQ was a self-informing examination). It may be noted parenthetically that the maximum obtainable SA is 30+ years, and the corresponding maximum adult SQ is 120+ (see manual).

In the family history represented on Figure *2B*, two re-examinations of Subject 8 gave SQ 67 both times; two examinations of Subject 10 gave SQ's 98 and 95; two examinations of Subject 11 gave SQ's 67 and 66; two examinations of Subject 23 gave SQ 101 both times (one of these being a self-informing examination).

The relative stability of these SQ scores is in part due to the fact that the repeated examinations were made by the same examiner, although using different informants. No attempt has been made in these data to compare examinations of several examiners. Our experience on re-examinations in the major validation study shows only minor variation in scores from examiner to examiner or from informant to informant. It should be understood that the stability of these social maturity scores is definitely affected by the method itself which provides for obtaining information as to the usual, customary, or habitual performances of the person examined. Therefore, if the examination is properly administered, the principal variant should be the extent to which the informant is accurately informed. In practice there seems to be rather more variation in the skill of different examiners in employing the method than in the success

with which information can be obtained by the same examiner from different informants.

The tendency toward parent-progeny variation in social maturity is indicated in Table II. In this table the SQ's of each mating pair have been averaged to yield a mid-parent SQ. The SQ of each offspring for each mating has been paired with this mid-parent SQ. All matings for the three family history groups here studied have been summarized in this table. Since the table is based on selected data and does not show normal distributions, a statistical coefficient of correlation is of doubtful value. However, the calculation gives $r = .75$, PE .04. The median mid-parent SQ is found to be 81.5, and the median offspring SQ is found to be 93.5. No attempt is made here to study sex-linked and sex-crossed relationships, but the data afford some possibility for doing so. The increase of SQ of offspring over that of mid-parent is specially noteworthy.

Of special interest in these data are the mating trends. In the superior family, Figure 2*A*, there are eight matings. In four of these matings the SQ of the male is superior to the female, with a mean SQ difference of 10 points. In three instances the female is superior to the male, with a mean difference of 14 points. In one instance the male and female SQ's are the same. It is, of course, difficult for the female to mate toward superiority in superior mating groups.

In Figure 2*B*, in five matings, four males are superior to their mates with a mean difference of 21 points, and one female is superior to her mate with a difference of 6 points.

In the feeble-minded family strain, Figure 3, seven males are superior to their mates with a mean difference of 17 points, while two females are superior to their mates with a mean difference of 7 points. Here, and in Figure 2*B*, we find a larger proportion of females mating upward, and by larger amounts as compared with Figure 2*A*.

The most conspicuous discrepancy in mating is found in the mating pair which unites the left hand branch of Figure 3 with the right hand branch. Here we have a female SQ of 33 mated with a male SQ of 76. As noted above, these adult SQ scores should not be interpreted on the same basis as adult IQ scores, since the corresponding age scores are not the same. Converting these SQ's back to their respective SA's this mating shows a female SA of 8 mating with a male SA of 19. This mating is therefore not one of a low-grade imbecile (as might be inferred from an *IQ* of 33, which represents adult MA 4) with a high-grade moron (as might be inferred from *IQ* 76, which represents adult MA 11), but of a low-grade moron (SQ 33, SA 8), with a borderline normal (SQ 76, SA 19), insofar as SA's can be taken in themselves as indicative of such categories.* As noted previously, these scores are only first indications of such possibilities and ***should not be used alone for diagnostic classification.***

In the normal standardization sample (data not presented here) there were ten matings in which seven males were superior to their mates with a mean difference of 11 points, and three females were superior to their mates with a mean difference of 3 points.

This shows for these samples, twenty-two males superior to their mates with a mean difference of 15 points, and nine females superior to their mates with a mean difference of 8 points. The data as a whole show a tendency for women to mate toward superiority, and a tendency to do so by larger amounts of difference in the inferior family groups. Obviously these data are too

*Consideration of the items of the scale, supported by experimental evidence not yet published, gives the following adult SA limits for the different degrees of mental deficiency: idiocy, SA 0 to 2; imbecility, 3 to 7; moronity, 8 to 18. These are tentative and approximate limits and may require later modification (see also Edgar A. Doll. Idiot, Imbecile, and Moron. *Jour. of Applied Psychology* 20:427-37, August, 1936).

limited to warrant positive inferences, but they do suggest an interesting trend which is in conformity with other evidence on the tendency for women to mate toward superiority. The matings of these charts are of further interest if the SQ's are taken as measures of normality or deficiency.

The above data support the thesis that quantitative measurements in family history studies are both desirable and practicable. The results of such measurement reveal trends and suggest problems of genuine importance. In particular these charts indicate the feasibility of using the Vineland Social Maturity Scale for this purpose.

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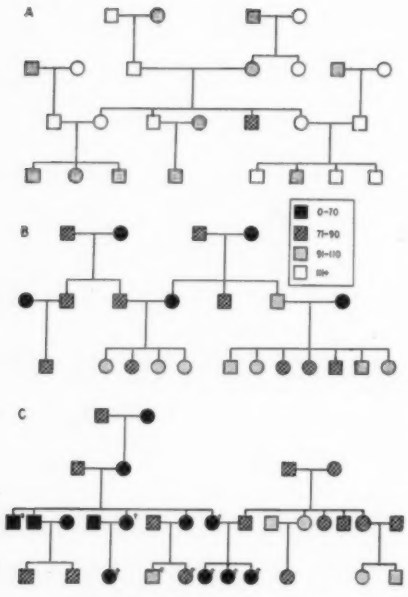
THE "SQ" IN EUGENICS AND HUMAN GENETICS

DISCUSSIONS of ways and means to develop a comprehensive eugenics program eventually touch on and infrequently disintegrate on, the thorny question of an objective evaluation of the eugenic worth of individuals, of groups, and of social classes. This has been true largely because there has been an almost complete lack of objective methods of estimating in advance the value to society of individuals and of groups. In the field of mental testing, very encouraging progress has been made. Properly applied, the IQ and some of the other psychological "Q's" have unquestioned statistical validity when dealing with groups, though to say that in every instance a final determination of the mental status of an individual is possible on the basis of a single intelligence test is to be overly optimistic. Unfortunately for purposes of easy classification, the complete human being is more than merely a psychological machine. He has to use what intelligence he is blessed with in a functioning social organism, cooperating and competing with other human beings. The social integration of a personality may, as a matter of fact, be of even greater importance than the purely intellectual components in evolving that socialized organism, the adult human being. To be "socially feeble-minded" (if we may be pardoned an inaccurate but rather descriptive term), is generally just as fatal to successful integration in human society as to be a "mentally feeble-minded." This is recognized in the accepted definition of feeble-mindedness which emphasizes mental under-development and social insufficiency jointly as the final criteria in rating a personality below the minimal grade essential for normal integration.

In the evaluation of social maturity a most important step forward seems to have been made with the development of the Vineland Scale, which is designed to determine the individual's social worth much as the Stanford-Binet Scale evaluates abstract intelligence. Combining the social and the intellectual indices (SQ and IQ) we have a far more complete picture of the potential worth of an individual than when intellectual attainments alone are considered. Obviously an individual distinctly below the human level as far as social integration is concerned is not good eugenic material any more than sub-normal mentality is good eugenic material. The high correlation between IQ and SQ noted by Dr. Doll means that in a great majority of cases



SEGREGATION IN SQ'S

our marginals and sub-marginals will be counted out on the basis of both social and intellectual insufficiency. (This fact is probably an important confirmation, by an independent approach, of F. A. Woods' contention that mental and moral traits are rather highly correlated. While it would be hazardous to allege at this stage that the SQ is a "moral quotient" pure and simple, we might reasonably expect a rather high correlation between the two character-complexes.)

It is obviously no simple matter to arrive at an exact genetic interpretation of the number and potency genes conditioning development of social adequacy, and of the optimum environment to bring them into expression. The pedigree charts which accompany Dr. Doll's article leave little doubt that degree of social adjustment tends to run in families. In Figure 4 we have a crude demonstration of this fact, based on re-drawing Dr. Doll's three charts so that the SQ's are brought together into four groups: (1) those with SQ's below 70, indicating presumptive feeble-mindedness; (2) the subnormal group (SQ 71-90); (3) normal group (91-110); and (4) the supernormal group (111 +). This brings to the eye the fact that in these families there is a tendency for "like to beget like," and a definite segregative tendency in the progenies of some of the matings. The fact that the SQ's of some children exceed that of their parents does not necessarily indicate non-mendelian inheritance, as suggested by Dr. Doll. We have many instances in experimental genetics in which complementary genes produce a character exceeding that found in either parent. Genetically the important and significant point appears to be that we do have definite plus and minus variations on a magnitude which can easily be measured. Merely on the basis of these observations we would hardly be justified in postulating any genetic mechanism for the inheritance of "sociality." These pedigrees do strongly suggest that the technique offers excellent research material which, if carefully used, should produce very valuable results.

Quite likely it will be argued that training and environment have more effect in altering an essentially normal SQ make-up than it might inaltering an intelligence quotient, and that some of these segregative tendencies are to be explained by this fact. Nevertheless there is considerable evidence in support of Dr. Doll's conclusion, from observations on identical twins, foster children, etc., that there seem to be definite developmental limits to the unfolding of the social personality, just as there are limits to the development of intelligence quotients. The problem in human genetics which Dr. Doll has posed in evolving a more exact method of measuring social maturity may in the end prove more complicated, challenging, and in the end more fruitful of fundamental knowledge than any simplifications he may have brought to the diagnosis of feeble-mindedness.

There is an interesting eugenic implication in the steps embodied in the social maturity scale. Thus the gap between the newly born infant and the socially mature individual is expressed in the contrast between (1) "crows," "laughs" and (117) "advances general welfare." As eugenic concepts develop in breadth and in effectiveness, it brings a new principle into social philosophy, which attempts to study human society not as a matter of the moment but as a going concern, demanding a rigorously intelligent and an adequately long term view. We must think not only of today and tomorrow, but next week, next year, and of generations yet unborn. When this is done on an effective and humane basis, then Dr. Doll or his successors will have to add to their list one more category—"Advancing racial welfare," which requires a breadth of vision and a persistence of purpose possibly significantly greater than that necessary to advance the general welfare at a given moment in the long history of our race.—EDITOR.

COLOR INHERITANCE IN SHORTHORN CATTLE

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COMPLETE records of colors in the herd of Shorthorn cattle owned by the University of Illinois have been kept since 1903. The colors have been classified in the usual way as red, red and white, roan, and white. Records from the herd books of the American Shorthorn Breeders' Association as given by Barrington and Pearson,[1] Bruce,[2] Duck,[3] Wentworth,[5] and Wilson,[6] show that matings between any two colors may have recorded progeny of all colors common to the breed, though very few in certain classes are found. The results, however, can not be explained on either a single or multiple factor basis.

The distribution of color in the University of Illinois herd, covering a period of thirty-three years, fits closely the theory of a single factor difference in which red is *RR*, white *rr* and roan *Rr*. Table I gives the results of the various matings. If the red and red and white are genetically the same in respect to color but differ only in a spotting factor, these two classes should be combined. If red and white individuals are the ones showing recessive spotting, matings with red individuals ought to give, if the red is homozygous for self color, only reds; but if heterozygous, two classes, red and red and white, in equal numbers. If reds, homozygous and heterozygous for self color, exist in equal numbers, a ratio of 3 reds to 1 red and white should be produced from matings to red and white. From these matings 9 reds and 3 red and whites were produced, a number too small to be significant. If we assume that of the reds half are homozygous for self color and half are heterozygous, random matings among these should give 15

TABLE I. Colors of Progeny from Shorthorn Matings, University of Illinois Herd

Mating	Colors			
	Red	Red and White	Roan	White
Red x red	9	---	---	---
White x white	---	---	---	2
Roan x roan	20	13	44	41
Red and white x red and white	---	1	---	---
Red x roan	15	12	22	---
Red x white	---	---	5	---
Red x red and white	9	3	---	---
Roan x white	---	---	28	29
Roan x red and white	6	16	13	---
White x red and white	---	---	7	---

TABLE II. Results of Shorthorn Matings when Red and Red and Whites are Combined

Mating	Color		
	Red	Roan	White
Red x red	18	---	---
White x white	---	---	2
Roan x roan	36	66	41
Roan x red	49	35	---
Roan x white	---	28	29
Red x white	---	12	---

TABLE III. Colors of Grandparents of Progeny in Table I and Colors of Their Offspring (Parents of Individuals in Table I)

Color of Grandparents	Color of Parents			
	Red	Red and White	Roan	White
Red - red	23	4	---	---
White - white	---	---	---	1
Roan - roan	6	30	12	3
Red and white - red and white	---	4	---	---
Red - roan	10	8	35	---
Red - white	---	---	36	---
Red - red and white	1	1	1	---
Roan - white	---	---	25	10
Roan - red and white	1	2	5	---
White - red and white	---	---	7	---

TABLE IV. Colors of Parents of Progeny in Table I and Colors of Their Parents (Grandparents of Individuals in Table I) Red and Red and White Combined

Grandparents	Color of Parents		
	Red	Roan	White
Red	33	---	---
White	---	---	1
Roan	9	30	12
Roan - red	21	40	---
Roan - white	---	25	10
Red - white	---	43	---

reds to 1 red and white. Combining the matings of reds from Tables I and III, 28 reds and 4 red and whites are produced. On the basis of a 15:1 expectation the observed is a fairly good fit, D/E = 2.17.

Table II gives the results of matings when reds and red and whites are combined.

Results of all types of matings agree well with the theoretical expectations on the basis of a single factor difference and of roan being the heterozygous form between red and white. Roan × roan gave 38 reds, 66 roans, and 41 whites. On the basis of a 1:2:1 ratio, P = .537. Roan × red and roan × white would each give a theoretical ratio of 1:1. D/E for each of the observed ratios respectively is 2.26 and .196.

Colors for most of the grandparents had to be obtained from the herd books. The results are recorded in Tables III and IV. The population represented by the offspring of the grandparents, which are the parents of the individuals in Tables I and II, does not represent a random sample because they have been selected as breeding stock. Yet, if only a single pair of factors is involved in the production of the various colors found among Shorthorns, there should be no departure from the expected classes. Among the various possible matings only one exception to the theoretical expectation was found. This exception is one individual classified as a roan with one parent classified as a red and the other as *RWM*, red with white markings (Table III). This type of mating gave 23 reds and 4 red and whites. The dam of the exception was marked in the herd book as *RWM*.

When only individuals produced in the University of Illinois herd are considered, the results can be explained satisfactorily on the hypothesis that the difference between red and white is due to a single gene and that roan is the heterozygous condition. As pointed out by Ibsen[4] this simple theory does not apply satisfactorily to results obtained from a cross between white Shorthorns and black breeds such as the Angus. Again, certain genes may be present in some Shorthorns and not present in the Illinois herd, which might be responsible for classes not expected on a simple monohybrid basis with incomplete dominance.

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DIFFERENCES IN CANCEROUS AND NON-CANCEROUS MICE

1. There was the generally lower oxygen consumption of the tissues of the tumour-strain-mice, as had previously been observed by Büngeler.

2. In addition the following factors were possessed by the tumour-strain-mice and correlated with their oxygen deficiency; (*a*) larger liver; (*b*) lower hæmoglobin; (*c*) lower red cell count; (*d*) lower red cell volume.

3. The tumour-like-mice also had (*a*) more calcium in their soft tissues; (*b*) a more alkaline pH. This Table also shows the following differences between the tumour-bearing and non-tumour-bearing mice of tumour-strain: (1) Those not bearing tumours showed a tendency to overcome the low hæmoglobin by an increased red-cell volume. (2) Those not bearing tumours had generally less calcium in their soft tissues.

The foregoing, and probably other factors, differentiated the tumour- and non-tumour-strains and the tumour- and non-tumour-bearing mice studied. The fact that most of the differences between the tumour- and non-tumour-strains also applied to the males and females not bearing tumours makes it seem probable that these differences were not the result, but rather predisposing factors, of tumour. — J. E. Davis in *Jol. Canad. Med. Assoc.*, Jan., 1937.

TURKEY-CHICKEN HYBRIDS

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MUCH interest has been manifested, from time to time, in the possibility of obtaining turkey-chicken hybrids. Moreover, occasional reports of an alleged cross have been made, but the so-called "turken" has invariably proved to be merely a naked-neck fowl. Differences in body weights and mating habits make it seem rather unlikely that such a cross would ever occur under natural conditions. Differences in length of incubation period, and in the number and morphology of chromosomes in the two genera, may present more serious obstacles to making this cross.

Warren and Scott[8] have demonstrated, however, that it is possible to obtain fertile eggs from both Bronze turkeys and Rhode Island Red chickens which have been inseminated with sperm of the other genus. Although the percentage of fertility of the eggs obtained from these matings was very low, and most of the embryos which were viable died at an early stage of development, one 22 day embryo was obtained which had attained a development equal to the normal turkey embryo at 25 days. In further description of this embryo the authors state that it possessed "most of the characteristics of the normal turkey except that the down was lighter in color, especially about the head and neck."

More recently Ogorodny[5] has reported that Spasskoy has obtained a live hybrid from a rooster and a turkey hen. Few details regarding the characteristics of this hybrid are given in the report.

The present study was undertaken in order to determine whether or not it was possible to obtain fertile eggs and hybrid offspring from artificially inseminated matings of turkeys and chickens, using the sperm of one genus to inseminate the other.

Methods of Procedure

Rhode Island Red, White Wyandotte, and crossbred males (R. I. R. ♂ × B. P. R. ♀) were used in the experiments, mixed semen from several males in each group being used to inseminate the Bronze turkey females. Mixed semen from several Bronze turkey males was used to inseminate Rhode Island Red females. Inseminations of Bronze turkey females with chicken semen were begun in June, 1935, and continued until September 15, 1935, when the turkey hens ceased to lay. They were begun again in March, 1936, and continued to June 15, 1936. The semen was obtained by the method reported by Burrows and Quinn[1] and the method of artificial insemination was that described by Quinn and Burrows[6].

Different groups of turkey females, 12 to 15 months of age, were used in 1935 and 1936. The turkey females used in 1935 had been mated with turkey males until May 1, when the turkey males were removed. The last fertile egg from the matings was obtained June 15, or 46 days after the removal of the males. Three White Holland and 10 Bronze turkey hens were inseminated with semen from chicken males in 1935. The four Bronze turkey females used in 1936 had never been previously mated.

Both groups of turkey females were inseminated every other day with a dosage of 0.2 cc of semen which had proved quite adequate for fertilization in fowls. On several occasions, dosages of 1.0 cc were given to try the effect of a larger dosage, but these did not increase the fertility. Semen from Rhode Island Red cockerels and from crossbred cockerels was used on the turkey females in 1935. Semen from Rhode Island Red, White Wyandotte, and crossbred cockerels was used on the Bronze turkey females in 1936.

HYBRID COMPARED WITH TURKEY

Figure 3

Fully developed turkey-chicken hybrid (*A*) compared with a 27 day turkey embryo (*B*). The hybrid obtained from an egg laid by a Bronze turkey hen crossed with Rhode Island Red males by artificial insemination. The hybrid was removed from the shell on the 28th day of incubation. It had died just at the completion of embryonic development.

Eleven Rhode Island Red females, about 12 months of age, which had never been mated to chicken males, were inseminated with the semen of turkey males from January 28 to June 15, 1936. Usually a dosage of 0.2 cc of turkey semen was given every other day, although smaller and larger amounts (0.1 cc to 1.0 cc) were used in attempts to increase fertility.

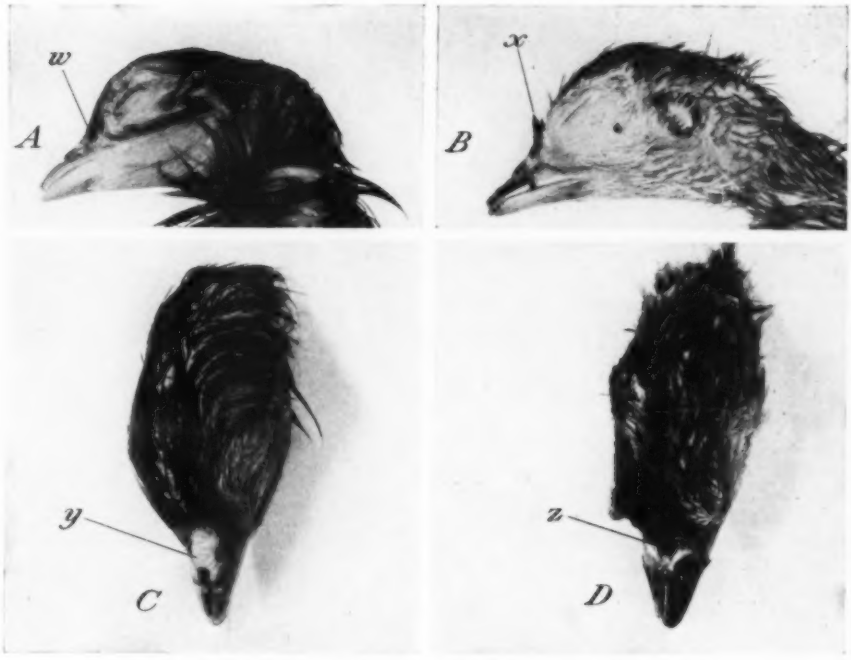
Results of Matings

The results of the fertility and embryonic mortality obtained from the chicken males × turkey females are given in Table I.

About 20 per cent of the eggs from the chicken ♂ × turkey ♀ cross were fertile, as noted in Table I, and this mating (chicken ♂ × turkey ♀) seems to offer fair possibilities for obtaining viable hybrid offspring.

In both the 1935 and 1936 periods, the fertility from the chicken ♂ × turkey ♀ matings was characterized by the irregularity of its appearance. At the beginning and end of the 1935 period, the fertility was better than in the intervening period. Nine out of 13 eggs set in September, 1935, proved fertile although all of the resulting embryos lived only one day. No fertile eggs had been obtained during the previous 10-day period. Similarly in 1936, six of the first 11 eggs laid were fertile and during the next 14 days all the eggs incubated proved infertile. During the remainder of the 1936 period, fertile eggs were obtained every other week following a week of infertility except in May when one or two fertile eggs were obtained each week for three weeks.

As will be noted in Table I, most of the embryonic mortality occurred within 24 hours of incubation, although one



HEAD OF HYBRID COMPARED WITH TURKEY

Figure 6

The head of the hybrid is shown at *A* and *C*, in comparison with that of a turkey embryo (*B*, *D*). The turkey poult has no comb, but a peculiar protuberance (shown at *X*), while the fowl chick has only a rudimentary comb. The hybrid resembles its male parent in having a comb (*y*) but lacking a protuberance.

hybrid lived until it was fully developed and apparently ready to hatch. This hybrid embryo was found dead in the shell on the 28th day of incubation, death having occurred sometime between the 23d and 28th day of incubation, no daily observations having been made after the 23d day. Consequently, the exact time of death, or the age of the embryo when death occurred, was unknown. The hybrid was obtained from an egg laid by a Bronze turkey hen on July 3, 20 days after the last fertile turkey egg had been obtained, and 66 days after the removal of the turkey male.

A photograph of the fully developed turkey-chicken hybrid is shown in Figure 5 in comparison with a 27 day turkey embryo in Figure 5. In both cases the yolk had been fully absorbed. The turkey embryo is considerably more elongated than the hybrid and more angular in contour. The contour of the hybrid appears to resemble that of the chick rather than the turkey. Moreover, the down color of the turkey is considerably darker than that of the hybrid, the latter being of a reddish cast in both head and body. The shanks of the turkey are quite dusky, whereas the shanks of the hybrid are yellow.

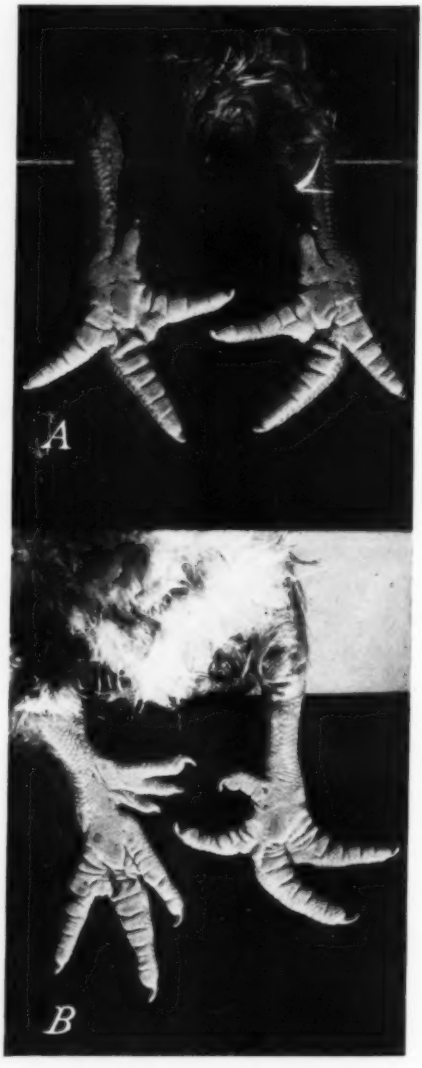
Other views of these embryos are shown in Figure 6. In Figure 6 it will be noted that the hybrid has a peculiar type of comb and no protuberance such as shown by the purebred Bronze turkey embryo in Figure 6 at *X*. The possession of a comb and the absence of a protuberance are possibly the most interesting and distinctive characteristics

of the turkey-chicken hybrid. According to Marsden[4] this protuberance is invariably found in turkeys. A front view of the heads of the two embryos is shown in Figure 6. In Figure 6 at *Y* the comb of the hybrid is shown as well as the absence of the characteristic turkey protuberance. In Figure 6 the protuberance of the turkey embryo is present and the comb is absent.

In Figure 7 are shown photographs of the shanks and feet of the turkey embryo and turkey-hybrid embryo. The contrast in down color between them is probably most clearly indicated in this figure, wherein the white ventral down of the hybrid may be clearly discerned. In Figure 7 are shown the dusky shanks, the dark posterior ventral down, and four toes of the normal turkey embryo. In Figure 7 is shown the hybrid with yellow shanks, white posterior ventral down, and a polydactylism in which the fourth toe of the left foot is triplicated.

If, in this intergeneric cross, the action of the genes concerned is modified slightly or not at all, then the reddish down and light yellow shanks of the Rhode Island Red may be considered epistatic to the darker down and dusky shanks of the turkey. This appears to agree with the statement of Serebrovsky[7] that the genes in interracial crosses behave as in intraracial or intraspecific crosses.

Regarding the polydactylism of the chicken-turkey hybrid in which the fourth toe of the left foot is triplicated, as shown in Figure 7, it may be stated that this agrees with observations made by Landauer[3] who stated that the posterior part of the body is more often affected in certain malformed embryos than the anterior part. Moreover, in at least one previous case, it has been shown that leg malformations and supernumerary toes have occurred in crosses of large and small fowls in which there were also poor fertility and hatchability. Kondirev[2] states that "a relatively high incidence of malformations coupled with low viability and low fertility are characteristic for several hybrid forms, especially when the parental somas differ greatly. Phenomena of an analogous nature appear to occur in the Bantam-Minorca, the



FEET OF THE "TURCHICK"

Figure 7

The dusky shanks, dark posterior ventral down and four-toed foot of the turkey embryo (*A*), is in contrast to the yellow shanks, white posterior ventral down, and extra-toed foot of the hybrid (*B*). The tendency to extra toes has been noted in at least one other wide cross in which there was poor fertility.

important difference in the case of these two breeds being that between their weights and rates of growth."

In Table II the fertility and embryonic mortality for the turkey males × chicken females is given.

In the matings of Bronze turkey males with Rhode Island Red females, there is a decided contrast between the fertility obtained and that shown for the reciprocal matings in Table I. Although 656 eggs were incubated from the artificially inseminated Rhode Island Red females, only five eggs, or about three-fourths of one per cent, were fertile, whereas in the reciprocal mating approximately 20 per cent were fertile. Of these five fertile eggs, only one developed into an embryo, which lived for three days, the other four dying within the first 24 hours of the incubation period.

Apparently, it is much less difficult to obtain fertility from the chicken ♂ × turkey ♀ cross than from the reciprocal mating. This agrees with the results of Warren and Scott[8]. In wide crosses it is not unusual to obtain better fertility from one mating than from the reciprocal. Microscopic examination of samples of the turkey semen used to inseminate the Rhode Island Red females indicated that the turkey spermatozoa were motile and appeared to be quite normal.

Summary

It has been shown that fertile eggs can be obtained by artificially inseminating both turkey and chicken females with sperm of the other genus. The fertility obtained was quite unsatisfactory. Twenty per cent of the eggs from the chicken ♂ ♂ × turkey ♀ ♀ matings and less than one per cent of the eggs from the reciprocal mating proved fertile. Attempts to increase fertility by various changes in procedure proved unsuccessful. There was little appreciable difference in the percentage of fertile eggs obtained from eggs fertilized by the semen of the standardbred or crossbred males, or when larger or smaller dosages of chicken or turkey semen were given.

About 85 per cent of the embryos in fertile eggs died during the first day of incubation, although one hybrid lived until fully developed and apparently ready to hatch. This hybrid was intermediate in conformation between the chicken and turkey. In various external characteristics such as head type and shape, down color, and shank color, it showed the characteristics of the chicken rather than the turkey.

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TABLE I. Fertility and embryonic mortality in eggs from artificially inseminated matings of chicken ♂ ♂ × turkey ♀ ♀.

Time of year eggs were set	No. eggs incubated	No. eggs fertile	Per cent fertile	Age of embryo at death				
				1 day	2 days	3 days	6 days	23-28 days
June, 1935, to Sept. 15, 1935	168	34	20.2	26	4	2	1	1
March, 1936, to June 15, 1936	110	22	20.0	16	4	2		
Total	278	56	20.1	42	8	4	1	1

TABLE II. Fertility and embryonic mortality of turkey ♂ ♂ × chicken ♀ ♀ matings.

Time of year	No. eggs incubated	No. eggs fertile	Per cent fertile	Age of embryo at death		
				1 day	2 days	3 days
Jan., 1936, to June, 1936	656	5	0.76	4	0	1

SPLIT-HAND

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SPLIT-HAND is a representative of one of the best-known types of inheritable deformity, namely, that which affects the extremities. Typically, both hands and feet of the subject are altered by the suppression of the central digits and the overgrowth of the marginal ones. The grotesque member which results has often been likened to a lobster's claw.

The deformity doubtless originates during the second month after conception, when the limbs are developing. It has appeared independently many times in different races,—white, yellow,[1] and black,—and several hundred cases have been described in the literature. Though rare, it is therefore a deep-seated and universal potentiality of the human germ-plasm.

As is to be expected, the manifestation of this gene is influenced greatly by other genes, and these modifying factors, which differ from family to family, produce all sorts of intermediate and transition forms. Either hands alone, or feet alone, may be affected. The marginal rather than the central digits may be suppressed and the central digits fused into one. Or this may be found on one side while the other shows the split condition, as in the accompanying picture (Figure 8) of a hitherto unpublished case. Or the defect of one or more of the members may be a minor one, perhaps no more than a lack of fingernails, as shown strikingly in some of the pedigrees, extending through five generations, that are published by Aschner and Engelmann.[2]

The boy here described (who was brought to my attention by Dr. M. A. Bigelow of Teachers College, Columbia University) belongs to an intelligent family in which the trait has never before appeared, so far as the records show. His feet are normal. An X-ray laboratory furnishes the following data:

A film was made of the right arm and hand in the antero-posterior direction, and of the left arm and hand in the lateral direction.

On the right hand, one sees the thumb and finger with the metacarpals and phalanges properly formed. The other digits are absent, as well as the metacarpals of these digits. No ossification center for the carpus and neither the epiphysis of the radius nor of the ulna can be seen.

On the left hand one sees a single digit with three phalanges and apparently a metacarpal. None of the bones of the carpus shows any center of ossification and the epiphyses of the radius and ulna are lacking.

In spite of the radical disorganization of hand or foot that is involved, the process of development usually results in some sort of workable compromise. The compensatory growth associated with abnormal conditions is one of the features that always strikes a student of developmental mechanics most forcibly. And descriptions of persons whose hands are reduced to two enormous "fingers" frequently emphasize the fact that the subject uses a pencil easily, or even does needlework. This is also true of the boy pictured in Figure 8. Up to the present, he has shown remarkably little sign of being handicapped by his condition.

It is simplest to think of a single main gene as involved within a given family, the differences in manifestation being due to the influence of modifying genes that are different in each case but somewhat constant from one generation to another within the same family. In another family, some different gene may possibly be responsible for a similar effect. The gene in all cases is generally described as a simple dominant. Three objections to this description have been raised, but they are of questionable validity.

1. An excess of affected over normal appears in some studies. R. Ruggles Gates[3] suggests that "through increased viability or for some other rea-

son, [it] occurs in more than 50% of the offspring from crosses with the normal." It seems unnecessary to postulate increased viability for the possessors of such a defect. In any pedigree study, there is always the danger that affected persons will be reported more fully than the normal, because they are more striking and because they are the object of search. But in any case the numbers involved (e.g., 44:32) are so small that little weight should be attached to deviations from the theoretically expected 50:50.

2. R. Fetscher[4] published a pedigree which has been cited as suggesting recessive rather than dominant inheritance. It started with a 12-year-old boy, both of whose hands were split, though his feet were normal. There was one other affected person in the relationship, namely, a first cousin of the father.

There is no reason to suppose that split-hand may not be dominant in some families, recessive in others. A number of speculative remarks might be made, but further family histories must be accumulated before the point can be settled.

3. Lewis and Embleton,[5] who published very full and valuable pedigrees, thought that there is "a decided tendency for the deformity to die out" in later generations, which suggested to them that the germinal condition becomes unstable. Such a vague explanation is not needed. It would be surprising if such a deformity did not tend to die out in later generations in any given family, since there is certain to be some discrimination against an affected person in marriage or parenthood. Moreover, the affected person is in almost every case heterozygous, therefore only half of his offspring will show the abnormality. It will occasionally happen that all the children (especially if their number be small) of an affected person will be free from it and therefore will not transmit it. It is just as natural that a rare dominant defect of this sort should eventually become extinct in a given line, as

SEGREGATION OR MUTATION?

Figure 8

Split hand is an inherited deformity generally inherited as a dominant. Is this an instance of its appearance in a child of normal parents due to a new dominant mutation, or does it represent a tragic outcrop of a recessive gene concealed in the germ plasm of both parents?

it is that a family name should eventually become extinct; and Francis Galton pointed out the reasons why all family names must eventually disappear, either through failure of offspring or because all children born would be girls who would give up the family name on marriage.[6]

Why, then, has split-hand not disappeared from the human race? Obviously because new mutations are occurring. Even if every affected person were prevented from reproducing, the deformity would not become extinct, for it would still be created anew. It would doubtless be rarer, statistically, than at present, but its actual disappearance can not be hoped for.

On the other hand, given favorable opportunities, it may become fairly common in a given area. Hartsinck,[7] writing in 1770, describes and figures it as "crab-claw" in Dutch Guiana:

Regarding the "Touvingas" or two-fingered Negroes, it is observed that they are a peo-

ple who had only two large fingers on their hands and two large toes on their feet, similar to those of a crab. The wrist is somewhat larger than that of the average man: the thumb and little finger are more than twice the usual size, and stand out from the limb, have a bend at the tip, and appear as one piece of flesh on which there is something like a nail. The palm of the hand has no bends, but appears as a solid mass, yet the divisions can be felt. . . . After the declaration of freedom, these Negroes of Saramacca walked publicly through Paramaribo. . . . Many argue that they are not a distinct tribe or nation, but just a family who by accident or freak of nature have been thus deformed. These people are becoming very rare indeed, probably through intercourse with others, fast bastardising.

As R. Ruggles Gates, who called attention to this account, remarks, they must have been fairly numerous to justify a discussion of whether they were a "distinct tribe or nation." Through isolation and inter-marriage, homozygotes would be produced and the percentage of children born with the abnormality would increase rapidly.

Split-hand is a serious handicap to its possessor, and sentiment will doubtless lead affected persons more and more to avoid either marriage or parenthood. This will not result in its elimination from the race, but will prevent its spread. Eugenically, however, the abnormality is relatively insignificant.

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CHILDREN OF THE DEPRESSION POOR

That significant differences exist between the average body weights of children from different economic classes is well known. The weight of children from financially comfortable families exceeds that of children of the poor. The present depression has afforded an opportunity for studying in a large number of cases the effect of a transition from the former group to the latter, since many families that were finacially comfortable prior to the depression have become poor since then. A statistical analysis of some 5,000 such families living in certain cities in the eastern half of the United States has yielded interesting information. Weight and height data were obtained on children of typical working-class families, either by direct interview or by transcription from school records. The families chosen fell into three groups: "control families" that had remained financially comfortable during the period from 1929 to 1933, control families that had remained consistently poor, and families that had been comfortable in 1929 but became progressively poorer, reaching the economic level of the continuously poor families by 1933. The average weight of the children from the financially comfortable group was from 5 to 6 per cent higher than that of the children of the consistently poor families. The average weight of children of the "depression poor," however, showed a progressive decrease from a value about the same as that of the children of the financially comfortable families to one nearly as low as that of the continuously poor. Similar statistical studies have shown that the incidence of illness is highest in families of the depression poor. These data furnish quantitative evidence that, as far as the wage-earning class in the large urban centers is concerned, the children from families whose income has fallen to a low level have been most affected by the depression. The foregoing studies emphasize in a convincing manner the deleterious effect of poverty on the state of nutrition and health.—*Jol. Amer. Med. Assn.*

A RARE PUPILLARY DEFECT

Inherited by Identical Twins

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TWINS WITH RARE EYE DEFECT

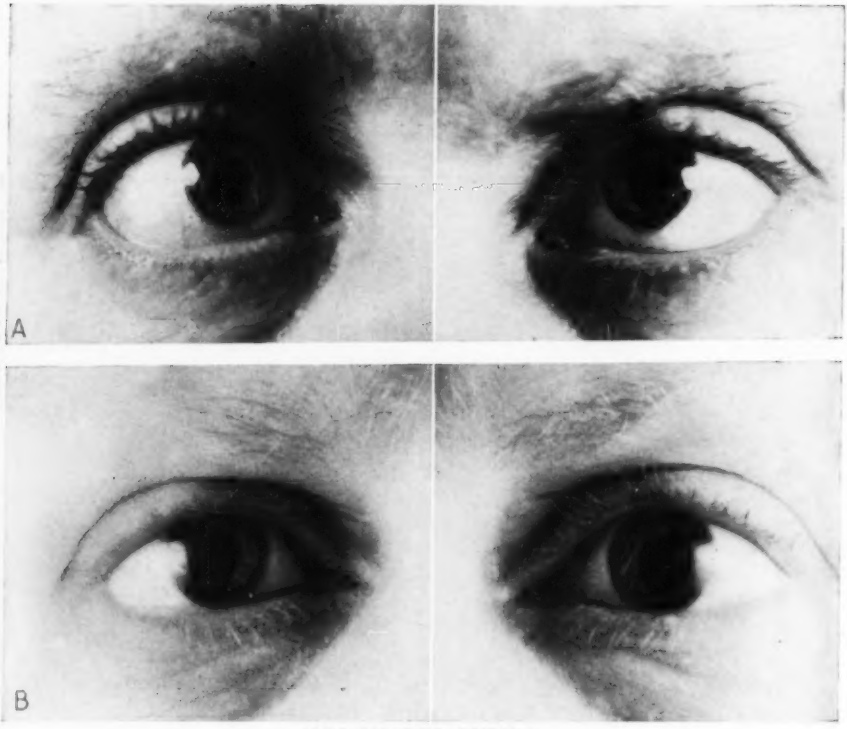
Figure 9

On the basis of a number of close similarities these twins appear to be identical. They have a very rare eye defect, in which the pupils are not able to accommodate normally to light by contraction of the iris (see Figure 10).

ALTHOUGH many characteristics of the human eye are transmitted by heredity, notably various degrees of coloboma, refractive errors, and iris color, inherited defects of the pupil alone are distinctly less common. Congenital *miosis* (pin point pupil) and *ectopia pupillae* are generally recognized in treatises on ophthalmology and on heredity.[6] *Membrana pupillaris perseverans, coloboma iridis,* and *aniridia* are also mentioned by Fuchs,[3] while de Schweinitz[2] notes as hereditary the cat-like pupil originally described by Greef. In this deformity the pupils constrict medially so as to form an elongated slit. DeSchweinitz[2] also states that slight inequality of the pupils may be hereditary.

Pupils with multiple irregular cup-shaped indentations into the margin of the iris are also described.[5] Lindberg[5] reports a series of four cases with this type of deformity. Gilbert[4] describes a single case and notes that the affected pupil is larger than the normal one, but reacts to light and on accommodation in the normal manner. Bernheimer[1] also reports a single case. All of these defects were unilateral.

The purpose of this communication is to report the finding of large irregular pupils in a pair of homozygous twins, a syndrome which Macklin[6] did not encounter in a review of over 3,000 case reports of hereditary abnormalities. The malformation observed in these twins is also said to have been present in the



EGG-SHAPED PUPILS

Figure 10

Detailed view of eyes of twins *S.L.* (*A*) and *C.L.* (*B*). In the presence of a bright light, the pupils can contract only in certain regions, giving an egg-shaped outline. The right eye of *C.L.* (*B*) has accommodated more than the other three eyes.

mother, now deceased.

Of the twins reported in this study, one, *S.L.*, has been a patient on two occasions in the Peter Bent Brigham Hospital. The other, *C.L.*, has been observed during her visits to her sister. The detailed history of our patient reveals no symptoms having an obvious bearing on the optic defect which is the subject of this report, but the history can be obtained by workers who are interested.*

On her second admission to the hospital (June 3, 1935), the patient's pupils were carefully observed. They were found to be extremely large, irregular, and to respond to light and during accommodation only in the superior temporal, and very slightly in the inferior nasal quadrants. Peripheral visual fields and visual acuity were essentially normal as was the ophthalmoscopic examination of the eye grounds.

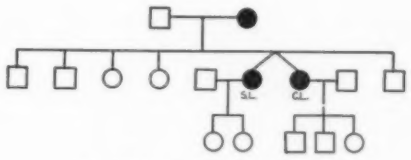
C.L. (Figure 9*B*) was not a patient at this hospital but was observed on visits to her sister. It was noted that her pupils in the resting state were in every respect identical with those of her sister. Under the strain of strong illumination, however, the right pupil showed a somewhat more marked constriction. (Figure 10.)

The women were of Russian Jewish

*Copies of the detailed medical history are on file with the American Genetic Association, and will be furnished with the author's reprints. The history may be obtained by writing the American Genetic Association.—Ed.

FINGERPRINT PATTERNS
Figure 11

Small differences in generally similar patterns characterize the twins.



IN TWO GENERATIONS
Figure 12

The mother showed this rare defect. When its extreme rarity is considered its occurrence in two generations is strong indication that heredity is involved.

extraction. They came to America at the age of 16. Their mother was living until after their 30th year and had always told them that they were identical twins. No information about the fetal membranes was available, but the following similarities justify the assumption that the sisters were identical twins:

1. *Homolateral Characteristics:* Asymmetrical pupils, deviation of nasal septa to the right, unilateral skin furrow over the bridge of the nose.

2. *Heterolateral (mirrored) Characteristics: S.L.'s* hair whorl, which permits parting on the right, *C.L.'s*, which permits parting on the left. The small mole on the right side of *S.L.*'s chin, on the left of *C.L.*'s.

3. *Dental Deformities:* Separation of the lower central incisor teeth in both subjects.

4. *Blood Grouping:* Both subjects of Moss's Group III, one of the less frequently encountered blood groups.

5. *Finger Prints:* Corresponding types of finger prints, on all fingers except the index fingers of the two hands. These finger print types are diagrammatically reproduced in Figure 11.

The *characteristics* of the pupils observed in these twins were: *a*, dilation; *b*, irregularity; and *c*, reaction to constricting stimuli only in the superior temporal and, to a lesser extent, in the inferior nasal quadrants. Slit lamp examination failed to reveal definite evidence of coloboma in either the iris or the choroid. There was, however, a small retinal naevus in the right eye of *C.L.*, a finding often seen in the presence of colobomata. Macklin[7] has suggested that the deformity may represent an inherent deficiency in the sphincter iridis muscle.

The family pedigree is given in Figure 12. The presence of the deformity in the mother of the twins suggests that the character is dominant in heredity. Its absence in the five children of the F_2 generation, all of whom have been examined by us, does not disprove this assumption, though it suggests that the gene for the iris deformity probably has normal overlaps and hence that it is an irregular dominant. The siblings of the twins do not show the defect so far as can be determined.

We are indebted to Dr. Clyde E. Keeler and Dr. Trygve Gundersen for valuable assistance they have given us in preparing this report.

Summary

1. The finding of large, irregular pupils in homozygous twins is reported.

2. The pupils were large, irregular, and incapable of responding to constricting stimuli except in certain quadrants, which were the same in both subjects.

3. The mechanism of inheritance seems to be irregular dominance.

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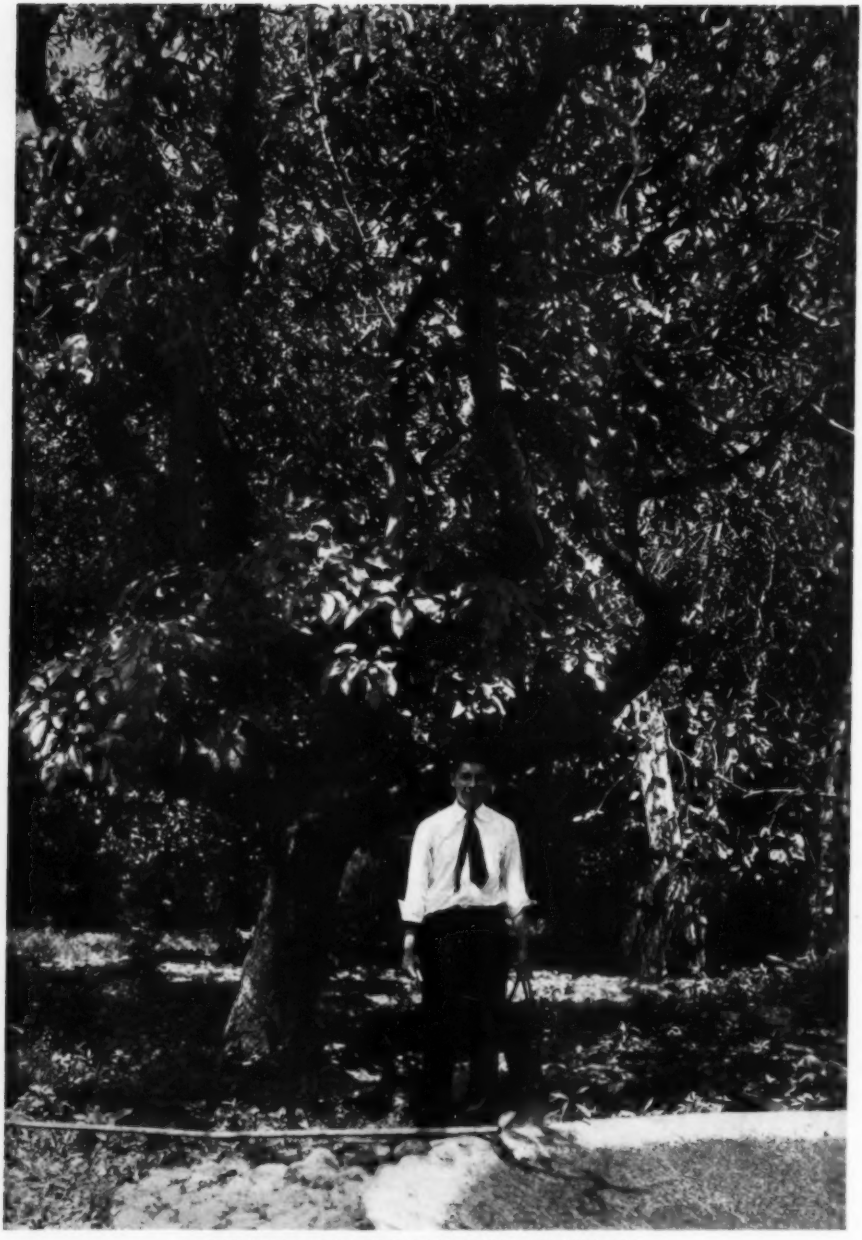

MOTHER OF THE "CALAVO" INDUSTRY

Figure 13

Parent Fuerte avocado tree in the LeBlanc garden at Atlixco, Mexico. It was first noticed in 1908 and buds were cut from it for testing in southern California in 1911. At th present time about 75 per cent of the commercial avocados raised in California are of this variety. Its fruits mature in December and January at Atlixco and are of a greenish color. Photographed October 7, 1936.

THE PARENT FUERTE AVOCADO

Three Quarters of California Avocado Industry Traces to Mexican Tree

A. D. SHAMEL
Principal Physiologist, Division of Fruit and Vegetable Crops and Diseases, Riverside, California

WHILE on a vacation trip to southern Mexico recently the writer took advantage of that opportunity to visit the parent Fuerte Avocado tree. About 75 per cent of the commercial avocado crop in California is produced by clonal progenies of this tree. For this reason the parent tree is of great interest to Californians who are growing this variety, or who are studying this industry, as well as those who are interested in commercially important fruit varieties and their origin.

The parent Fuerte tree is located in the garden of Senor Alejandro Le Blanc, 3 Poniente 24, Atlixco, Mexico. The city of Atlixco is reached over a fine paved highway, 18 miles from the city of Puebla, in the state of Puebla. Another shorter route from Mexico City is by way of an unpaved road from Cholula for a few miles until it joins the paved one from Puebla. The famous pyramid and historical city of Cholula are located about 14 miles distant from Atlixco. Puebla is about 80 miles east from Mexico City, while the distance to Cholula is about 4 or 5 miles less than that to Puebla.

Senor LeBlanc was away from home the day of our visit but we were graciously received by his wife, Senora Delfina Smith LeBlanc. She told us that the fine quality of the fruits of the parent Fuerte tree were first noticed in 1908 and that in 1911 Carl Schmidt collected buds from that tree for the West India Gardens of Pasadena, California. We found the identifying label which Mr. Schmidt placed there at that time.

Our measurements of the size of the parent Fuerte tree were made on October 7, 1936. The circumference of the trunk at 3 feet from the ground was 52 inches, or a diameter of 16.5 inches. The height of the tree was estimated to be about 45 feet. There were seven scaffold limbs arising at or near the head of the tree, which was 59 inches from the ground.

The appearance of the rather sparse foliage indicated that the tree was lacking in vigor of growth. The leaves were scant in number and more or less wilted and deficient in the deep green color that is so characteristic of normal vigorous growth. Senora LeBlanc attributed this condition to a lack of adequate irrigation water due to a defective main water flume. The writer noticed that the family washing was commonly done in a large cement tub near this tree so that the wash water probably drained into the soil about the nearby parent Fuerte tree. His idea is that the soap used in washing may be responsible in part at least for the tree's lack of vigor and poor condition generally.

The parent tree was found to be bearing a heavy crop which we estimated to number about 500 avocados; the fruits were about two-thirds grown. Senora LeBlanc said that the tree bore heavy crops one year and lighter ones the following season,—in other words, was alternate bearing. They would become mature during the months of December and January, approximately the same season of production as that for the fruits of this variety in southern California. The elevation of the city of Atlixco is about 6,150 feet above sea-level while in southern California most of the commercial plantings of this variety are located on the coast and transitional areas that are near the sea-level.

A SUMMER-RIPENING FUERTE
Figure 14

Summer bearing avocado tree in the LeBlanc garden. The fruits mature in June and July and are of the same shape and size (and the seeds are of the same size) as is the case with fruits of the parent Fuerte tree. The color of the fruits is purple while that of the fuerte avocado is green. The tree is said to be a heavy, annual producer and the fruits are of excellent eating quality, equal to if not superior to those from the parent Fuerte tree. Photographed October 7, 1936.

A Summer-Ripening Form

In the LeBlanc garden, about 100 yards from the parent Fuerte tree, is another avocado tree that matures its fruit in June and July, a summer producing tree. It was in full bloom at the time of our visit so that we did not have an opportunity to see its fruits. However, Senora LeBlanc stated that the avocados borne by this tree are of the same shape and size, and that the seeds in the fruits are of the same size, as is the case with the Fuerte avocados, and that the tree is a heavy bearer. The skin of the fruits of the summer-bearing tree is of a purple, or "negro" color in contrast to the greenish color of the Fuerte avocados.

The eating quality of the fruits of the summer-bearing tree is equal to, or superior to that of the Fuerte fruits grown in the same garden, according to Senora LeBlanc and her mother. From the fact that the progenies of the Fuerte tree in southern California mature about the same as the parent tree at Atlixco, it is reasonable to assume that the performance of progeny of the summer bearing tree in southern California will be similar to that of the parent tree.

An examination by the writer of the avocados offered for sale in the public markets at Mazatlan, Guadalajara, Mexico City, Puebla and Oaxaca during this visit convinced him that a systematic study of the seedling trees in selected districts of Mexico would be an important service to the avocado growers of California and perhaps to those in other avocado growing regions in the United States. In such a study the location of the seedlings, their season of production, their commercial and eating qualities, and other factors, should be kept in mind so that the suitability of their progenies for the districts of the United States where they may be tested could be evaluated with a fair degree of accuracy.

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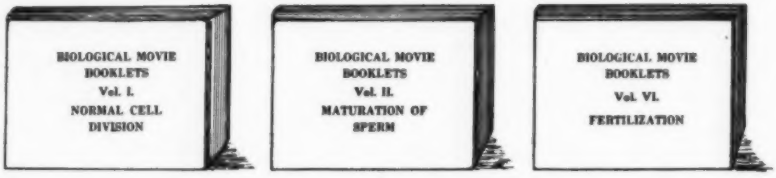

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